

## KOMPARATIVNA SEM ISPITIVANJA POJEDINIХ SAVREMENIH PREPARATA ZA PREVENTIVNO ZALIVANJE FISURA

## COMPARATIVE SEM EXAMINATIONS OF CERTAIN CONTEMPORARY MATERIALS FOR PREVENTIVE SEALING OF FISSURES

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### **Kratak sadržaj**

Za uspešnu realizaciju profilaktičke metode zalivanja fisura neophodni su adekvatan izbor, planska primena savremenih materijala (kompozitni zaličivači, kompozitni zaličivači sa fluorom, kao i najnoviji smolom ojačani glass-jonomeri) i adekvatno sprovedena tehnika aplikacije istih.

Cilj rada bio je SEM analiza kontinuiranosti i debljine zaličivača primenom tri materijala: Fisural®, Fisurit-F® i Ionosit-seal®. Utvrđeno je da Ionosit-seal poseduje sposobnost održavanja kontinuirane debljine na zaličenim površinama fisure i nakon 1-ne godine od primene, za razliku od ostalih zaličivača.

**Ključne reči:** karijes, fisura, zalivanje i SEM ispitivanja

### **Uvod**

Zalivanje fisura predstavlja, preventivno-terapeutsku metodu kojom se na jednostavan, bezbolan i ekonomičan način može sačuvati morfološko-funkcionalni integritet gleđi u fisurnom sistemu premolara i molara. Aktuelnost ove metode je utoliko veća, što konvencionalni metod endogene i egzogene prime-ne fluora ne može u potpunosti da obezbedi visok procenat redukcije karijesa u predilekcionim mestima na okluzalnim površinama mlečnih i stalnih zuba.<sup>1,2,3</sup>

### **Abstract**

For a successful final realisation of sealing offissures as a prophylactic method, what is necessary is adequate choice, using of contemporary materials (composite sealants, composite with fluor as well as the latest glass-ionomer resin reinforced) and adequately pursued technique of their application as well.

The aim of the work was SEM examination of continuous thickness of the sealing with different materials: Fisural®, Fisurit-F®, Ionosit-seal®. There was been determined that Ionosit-seal shows the best results in the quality of fissure sealing.

**Key words:** caries, fissure, sealing and SEM examinations

### **Introduction**

Sealing of fissures represents, preventive-therapeutic method by which, in a simple, painless and economical way, the morphological-functional integrity of enamel in the fissure system of premolars and molars can be saved. Actuality of this method is so much greater because the conventional method of endogenous and exogenous application of fluor cannot fully secure a high percentage of reduction of caries in predilection places on occlusion surfaces of milk and permanent teeth.<sup>1,2,3</sup>

Fisurni sistem zuba je jedinstven, odvojeni, ekološki entitet smešten unutar oralnog miljea. Zbog svoje specifičnosti ovaj sistem je neobično zanimljiv, kako zbog morfoloških osobina, tako i zbog varijabilnosti mikrobiološkog sastava, budući da su fisure i jamice mesta prvog pojavišnjivanja zubnog karijesa.

Prema navodima u literaturi Bajraktarova i sar.,<sup>4</sup> Fuks i sar.<sup>5</sup> prvi pokušaj preventivne zaštite fisura od karijesa aplikacijom cementa, datira još od Willsona 1895. godine. Nešto kasnije, tačnije 1922. godine Hyatt je sa istim ciljem, koristio srebrni ili bakarni cement za popunjavanje dubokih fisura i jamica na tek izniklim zubima.

Iz tog perioda, opisane su i solucije različitih soli, korišćenih u tu svrhu, u različitim koncentracijama, a to su srebro-nitrat, zink-hlorid, kalijum-fero-cijanat, kao i različiti materijali na bazi poliuretana i cijanoakrilata.<sup>6</sup>

Međutim, vremenska ograničenost preventivne zaštite fisura i jamica od nekoliko dana primenom navedenih solucija i njihovih redukcionih sredstava, potvrđena u praksi, zbog razgradnje stvorenog jedinjenja nije trajnije rešila problem prevencije karijesa u njima.

U traganju za povoljnijim materijalima istraživanja su krenula u dva pravca. *Prvi*, koji je i preuzeo primat, uvodio je organske smole. Organske smole su se kombinovale sa neorganskim česticama i na taj način su sintetizovani materijali, danas poznati pod zajedničkim nazivom **kompozitni zalivači**.

U toku razvoja i usavršavanja javljaju se **četiri generacije kompozitnih zalivača**. Predstavnik **prve generacije** bio je zalivač *Nuva Seal* (1970) čija se polimerizacija aktivirala pomoću UV zraka. On nije stekao veću kliničku popularnost zbog niza nedostataka i štetnosti UV zraka.

Tokom 70-ih godina javlja se **druga generacija dvokomponentnih kompozitnih smola**, koji se polimerizuju preko hemijske polimerizacije (autopolimerizacija).<sup>7</sup>

Ova druga generacija zalivača, napušta se sredinom 80-ih godina, kada se uglavnom prelazi na svetlosno polimerizirajuće (plava svetlost od 470 nm) jednokomponentne smole ili **treću generaciju** kompozitnih zalivača, što omogućuje jednostavniji rad i bolju penetraciju u dubinu, zbog manjeg viskoziteta i površinskog napona.<sup>8,9</sup>

The fissure system of teeth is a unique, separate, ecological entity situated within the oral milieu. Due to its specificity, this system is unusually interesting, both because of morphological qualities and because of variability of microbiological structure, considering the fact that the fissures and pits are the places of the first appearance of tooth caries.

According to the statements in literature, Bajraktarova et al.<sup>4</sup> Fuks et al.<sup>5</sup> the first trial of preventive protection of fissure from caries by application of cement dates back as early as Willson in 1895. A bit later, more exactly 1922, Hyatt, with the same aim, used silver or copper cement for filling up deep fissures and pits on teeth that just appeared.

From that period, there have also been described solutions of various salts, used for that purpose, in different concentrations, such as silver nitrate, zinc chloride, potassium ferro cyanate, as well as various materials based on polyurethane and cyanoacrylates.<sup>6</sup>

However, the time limit of preventive protection of fissure and pits of several days, by application of stated solutions and their reduction means, confirmed in practice, due to demolishing of created compound, has not more permanently solved the problem of prevention caries in them.

In search of more favourable materials the researches started in two directions. The first, which took the lead, introduced organic resins. Organic resins were combined with nonorganic particles and in this way materials were synthetized, known today under a common name of **composite sealants**.

During the development and improvement there appeared **four generations** of composite sealants. The representative of **the first generation** there was sealant Nuva Seal (1970) whose polymerization was activated by way of UV rays. It did not acquire a greater clinical popularity due to a number of disadvantages and injuriousness of UV rays.

In the course of the seventies there appears the **second generation** of twocomponent composite resins which polymerize through chemical polymerization (autopolymerization).<sup>7</sup>

This second generation of sealants is abandoned in the middle of the eighties when it mainly transfers to light polymeryzing (blue light of 470 nm) one component resins or the **third generation** of composite sealants which enables a simpler operation and better

Kompozitni zalivači ne sadrže aktivne kariostatske komponente, pa se njihova preventivna uloga bazira isključivo na fizičkoj izolaciji fisura od oralne sredine.<sup>7,8,9,10</sup>

Međutim, početkom 90-ih godina razvija se i **četvrta generacija** kompozitnih zalivača koji imaju sposobnost otpuštanja fluorida. Ovi, posred efektne mehaničke barijere obezbeđuju i jačanje gleđi i proces remineralizacije.<sup>11,12,13</sup>

*Drugi pravac istraživanja, u cilju da se u sveukupni kvalitet savremenog zalivača objedine brojna validna svojstva, u prvom redu njegova adhezivnost za gleđ, 70-ih godina na dentalnom tržištu pojavljuju se **glas-jonomer zalivači**, sa širim indikacionim mogućnostima (adhezija za gleđ, biokompatibilnost, koeficijent termičke ekspanzije, koji je veoma blizak gleđi i antikariogeni efekat).*<sup>14,15,16</sup>

Međutim, glas-jonomer zalivači imaju i brojne nedostatke, a to su: niska otpornost na mehanička opterećenja, abrazivnost, osetljivost na vlagu i dehidrataciju.

Danas se GJ i kompozitni zalivači fisura bore za vodeću poziciju u ovoj značajnoj i od WHO<sup>17</sup> i ADA<sup>18</sup> priznatoj metodi (WHO, 1994<sup>17</sup>; CDMIE, 1990<sup>19</sup>).

Krajem 80-tih dalji tehnološki razvoj materijala za zalianje fisura rezultirao je pojmom novih, savršenijih zalivača, koji predstavljaju sublimaciju pozitivnih osobina kompozitnih materijala (mehanička i estetska svojstva, otpornost na uticaj vode) i glas-jonomera (adhezivnost i kariostatsku) poznati kao **smolom ojačani glas-jonomer zalivači**.<sup>20,21</sup>

Brojnost i raznovrsnost prisutnih materijala, u pogledu hemijskog sastava za preventivno zalianje fisura, uslovila je na kliničkom planu dva tipa preventivno-terapijskih tretmana:

**Neinvazivni metod**, primenljiv prema većini autora u prevenciji karijesa na intaktnim stalnim Zubima u periodu od šest meseci do godinu dana posle erupcije, jer je to period u kome je poroznost gleđi i odsustvo bakterija, a naročito mikroorganizmi iz grupe **Mutans Streptokoka** u fisurnom sistemu, osnovni preduslov za adekvatnu adheziju upotrebljenog materijala.<sup>2,4</sup>

**Invazivni metod**, gde se zalianje ne ograničava vremenski u odnosu na posterutivni period, i može da se primeni u bilo kom uzrastu, kod zuba sa naglašenim fisurnim

penetration into the depth due to smaller viscosity and surface tension.<sup>8,9</sup>

Composite sealants do not contain active cariostatic components so their preventive role is based solely on physical isolation of fissures from oral environment.<sup>7,8,9,10</sup>

Meanwhile, in the beginning of the nineties there develops also the **fourth generation** of composite sealants which have ability of releasing fluoride. These, beside effective mechanical barrier also secure strengthening of enamel and process of remineralization.<sup>11,12,13</sup>

The second direction of research is in the aim to unite in overall quality of contemporary sealant numerous valid properties, primarily its adhesiveness for enamel and in the seventies there appear in the dental market **glass-ionomer sealants** (GJ) with wider indication possibilities (adhesiveness, biocompatibility, cariostatics effects).<sup>14,15,16</sup>

However, glass-ionomer sealants have numerous disadvantages and they are: low resistibility to mechanical loads, abrasiveness, sensibility to moisture and dehydratation.

Nowadays GJ and composite sealants of fissures fight for a leading position in this significant and by WHO<sup>17</sup> and ADA<sup>18</sup> recognized method (WHO, 1994<sup>17</sup>; CDMIE, 1990<sup>19</sup>).

In the end of the eighties, further technological development of materials for sealing fissures resulted in the appearance of new, more perfect sealants which represent sublimation of positive qualities of composite materials (mechanical and aesthetic properties, resistivity to influence of water) and glass-ionomers (adhesiveness and cariostatics) known as **glass-ionomer sealants resin reinforced**.<sup>20,21</sup>

Numerousness and variety of present materials, regarding chemical composition for preventive sealing of fissures, led to, in the clinical plan, two types of preventive-therapeutic treatments:

**Noninvasive method** applicable, according to majority to authors, in prevention of caries on intact permanent teeth in the period from six months to a year after eruption because that is the period in which the porosity of enamel and absence of bacteria, especially microorganisms from group **Mutans Streptococcus** in the fissure system, basic prerequisite for adequate adhesion of used material.<sup>2,4</sup>

sistemom kao i kod fisura sa znacima inicijalnog karijesa. Blago proširenje fisurnog sistema pruža višestruku prednost:

– Veću preglednost fisurnog sistema, pre njihovog zalivanja (odstranjuje se mogućnost "zalivanja karijesa"),

– Bolju retenciju zalivača.<sup>22,23,24</sup>

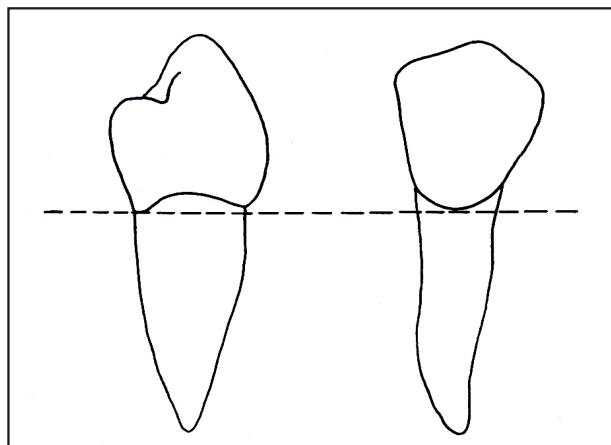
## Cilj rada

Cilj rada bio je SEM analiza kontinuiranosti i debljine zalivača, primenom tri materijala: Fisural®, Fisurit-F® i Ionosit-seal® i procena dobijenih rezultata o efikasnosti tretmana fisurnog sistema primjenjenim materijalima.

## Materijali i metode

Za SEM ispitivanje upotrebljeno je 36 zuba transkaninog sektora čija je ekstrakcija planirana iz ortodontskih razloga (12 zuba za svaki preparat u 3 opservaciona perioda). Nakon zalivanja, ekstrakcija je vršena posle 1 meseca, 6 meseci i 1 godine. Zalivanje je izvođeno nakon proširenja fisure (invazivni metod) sledećim materijalima: Fisural-om® (Galenika-Srbija), Fisurit-om-F® (Voco-Germany) i Ionosit-om-seal® (DMG-Hamburg). Zubi su posle ekstrakcije bili sečeni, kalupljeni i posmatrani scanning elektronским mikroskopom marke JEOL 5300.

Radi lakšeg rukovanja izvršeno je poprečno presecanje zuba u srednjoj trećini anatomske krunice zuba (u visini dna pulpne komorice), odvajajući, na taj način, krunu od korena zuba. (Sl. 1)



**Invasive method** where sealing is not restricted timewise in relation to posterruptive period and can be applied on any age, with the teeth with emphasised fissure system as well as with the fissures with signs of initial caries. Slight widening of fissure system offers multiple advantage:

– Greater clearness of fissure system, before their sealing (removing the possibility of "sealing caries"),

– Better retention of sealants.<sup>22,23,24</sup>

## The aim of the works

The aim of the work was SEM results continuous thicknes of the layer with those materials: Fisural®, Fisurit-F®, Ionosit-seal®, and gift a results about treatmant of fissure sealing.

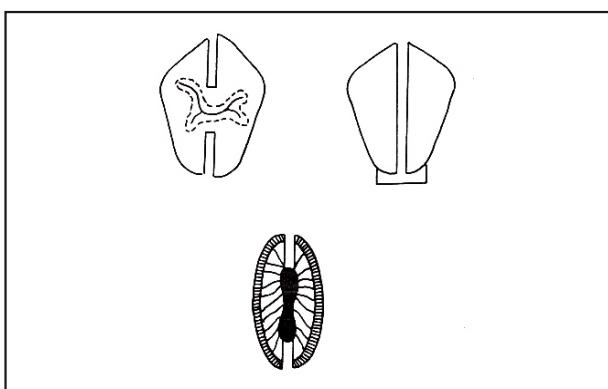
## Materials and methods

For SEM examination, there has been used 36 teeth of transcanine sector, extracted after sealing, for orthodontic reasons (12 teeth for each material followed in the period from 1 month, 6 months, 1 year – 3 observation period). The teeth were sealed by invasive method with different sealants: Fissural® (Galenika-Serbia), Fissurit-F® (Voco-Germany), Ionosit-seal® (DMG-Hamburg) so that they could be, after extraction, cut, moulded and observed by scanning electronic microscope of make JEOL 5300.

In order to have easier handling, there has been performed transversal cutting of teeth in the middle third of anatomic tooth crown (in the height of the bottom of pulp chamber) separating, in this manner, the crown from the root of the tooth. (Fig. 1)

Slika 1. Transverzalni presek u vratnom delu zuba  
Figure 1. Transversal cutting of teeth

Nakon odvajanja krunice zuba urađen je uzdužni presek (aksijalni presek) u srednjoj trećini okluzalne površine. Na taj način, dobijen je poprečni presek fisure u njenoj najvećoj dubini. Ovakvim postupkom, izbegava se oštećenje fisurnog područja i preparata za zalivanje fisurnog sistema. (Sl. 2a i 2b)



*Slika 2a. Aksijalni presek krunice zuba  
Figure 2a. Aksial cutting of teeth*

Dobijene polovine bile su obeležene i dok je jedna ostala kao rezerva, druga je korišćena kao uzorak za dalja ispitivanja. Odabrane polovine uzorka, lepljene su specijalnim lepkom (elektro provodljivim) za metalne nosače, mezijalnom ili distalnom stranom. Ovako pripremljeni uzorci unošeni su u aparat za vakuumsko naparavanje zlata tipa S-150 *Sputter coater-Edwards* u vakuumu  $10^{-1}$  torra. Na taj način uzorci su dobili omotač debljine 10-15 Å. Observacija svih uzoraka i fotografisanje vršeno je na elektronskom mikroskopu marke JEOL 5300 na Institutu za elektronsku mikroskopiju u Nišu.

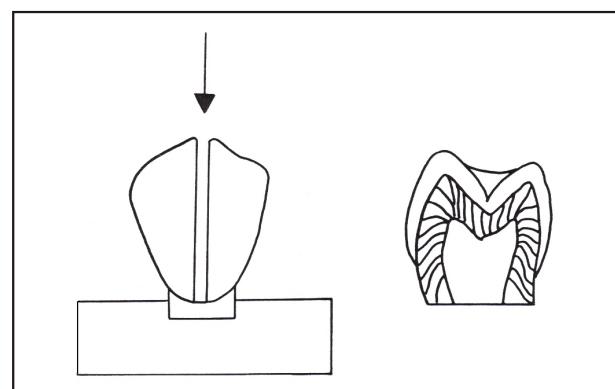
Na SEM mikrografijama analizirana je debljina i kontinuiranost senke zalivača radi procene retencije i marginalnog pripoja materijala.

## **Rezultati SEM analize**

Analizirano je 36 SEM snimaka radi procene efikasnosti retencije ispitivanih zalivača (po 12 snimka za svaki preparat u 3 opservaciona perioda: 1 mesec, 6 meseci, 1 godina).

Neke od dobijenih mikrografija prikazane su u radu.

After separating the crown of the tooth, there has been performed cutting alongside (axial cut) in the middle third of the occlusion surface. In this way, transversal cut of fissure is obtained in its biggest depth. With this action, there is avoidance of damaging the fissure area and preparations for sealing fissure system. (Fig. 2a and 2b)



*Slika 2b. Aksijalni presek krunice zuba  
Figure 2b. Aksial cutting of teeth*

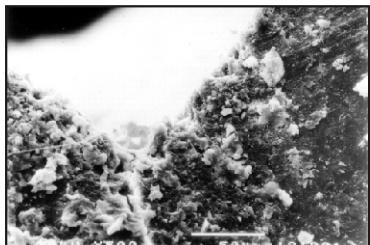
The received halves were marked and while one remained as reserve, the other is used as a sample for further research. The selected halves of the samples are glued with special glue (electro conductive) for metal carriers, by mesial and distal side. The samples prepared like this were inserted in an apparatus for vacuum steaming of gold type S-150 *Sputter coater-Edwards* in vacuum  $10^{-1}$  torr. In that way, the samples received coating of thickness 10-15A. The observation of all samples and photographing was done on an electronic microscope make JEOL 5300 at the Institute for Electronic microscopy in Niš.

On SEM micrographs, the thickness and continuity of the sealant shadow were analysed in order to assess the retention and marginal joining of the material.

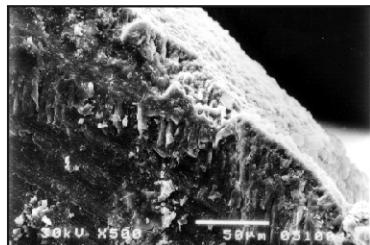
## **Results of SEM analysis**

For evaluation of the effect of retention of examined sealants were used 36 SEM micrographs (12 photography for every material in 3 opservation periods: 1 month, 6 months, 1 year).

Some micrography is shown in this work.



Slika 3.1. Fisural posle 1-og meseca  
Figure 3.1. Fissural after the 1<sup>st</sup> month



Slika 3.2. Fissurit-F posle 1-og meseca  
Figure 3.2. Fissurit-F after the 1<sup>st</sup> month



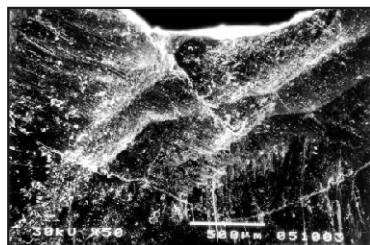
Slika 3.3. Ionosit-seal posle 1-og meseca  
Figure 3.3. Ionosit-seal after the 1<sup>st</sup> month

Posle 1. meseca, SEM nalaz potpune retencije svih ispitivanih zalivača. (Sl. 3.1, 3.2, 3.3)

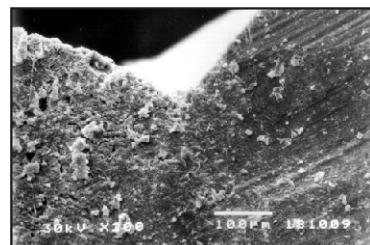
After the 1<sup>st</sup> month, SEM result of the full retention of all examined sealants. (Fig. 3.1, fig. 3.2, fig. 3.3)



Slika 4.1. Fisural posle 6 meseci  
Figure 4.1. Fissural after 6 months



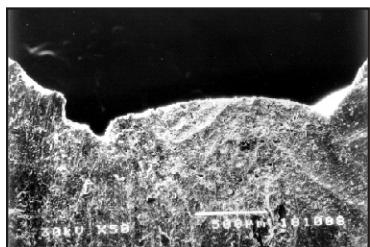
Slika 4.2. Fissurit-F posle 6 meseci  
Figure 4.2. Fissurit-F after 6 months



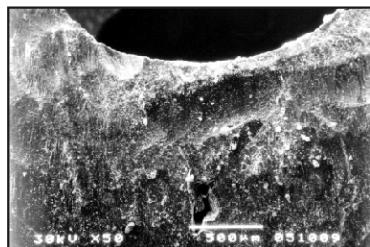
Slika 4.3. Ionosit-seal posle 6 meseci  
Figure 4.3. Ionosit-seal after 6 months

Nakon 6 meseci, kod Fisural®-a se uočava značajnije smanjenje debljine nanetog sloja, u odnosu na preostala 2 preparata. (Sl. 4.1, 4.2, 4.3)

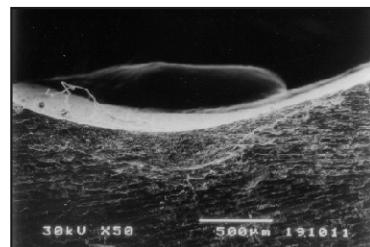
After 6 months, with Fissural® there is noted more evident slight lessening of the thickness of the placed layer in relation with the remained 2 sealants. (Fig. 4.1, fig. 4.2, fig. 4.3)



Slika 5.1. Fisural posle 1-ne godine  
Figure 5.1. Fissural after the 1<sup>st</sup> year



Slika 5.2. Fissurit-F posle 1-ne godine  
Figure 5.2. Fissurit-F after the 1<sup>st</sup> year



Slika 5.3. Ionosit-seal posle 1-ne godine  
Figure 5.3. Ionosit-seal after 1 year

Posle 1-ne godine, na SEM mikrografijama sva 3 preparata su prisutna u fisurama sa evidentno manjom debljinom sloja zalivača kod Fisural®-a i Fissurit®-a-F, u odnosu na Ionosit-seal. (Sl. 5.1, 5.2, 5.3)

After 1 year, on SEM micrographs, all 3 materials are present in fissures with evidently smaller thickness of the sealant layer with Fissural® and Fissurit®-F, in relation to Ionosit-seal. (Fig. 5.1, Fig. 5.2, Fig. 5.3)

## Diskusija

Specifična fisurna morfologija uslovljava da se karijesna lezija u fisuri ne može izbeći i pored izbalansirane ishrane, dnevne higijene oralne šupljine, kombinovane fluorizacije i redovnih stomatoloških pregleda, pri čemu se nameće potreba preventivnog zahvata u području same fisure.

Kako su dokazali Brannstrom,<sup>25</sup> Della Volpe,<sup>10</sup> Fucks i sar.,<sup>26</sup> Gift i sar.,<sup>8</sup> za zaustavljanje inicijalnih napredujućih lezija, u primeni sredstava za zalivanje, neophodan je uski prilegnuti rub ispuna kojim su zalivenе jamice i fisure.

Marginalna adaptacija ili intimni kontakt između gleđi i zalivača, bitan je faktor kod ovog preventivnog postupka. Svako rubno propuštanje, koje omogućava difuziju oralnog fluida, potencijalna je opasnost za nastanak sekundarnog karijesa. Brojna istraživanja pokazala su da marginalni odnosi između zidova fisura i zalivača nisu fiksni, inertni i nepropusni rubovi, nego su to mikropukotine u kojima se odvija veoma intenzivan transfer jona i molekula.<sup>26,27</sup>

Nagrizanjem gleđi Bounocore je ostvario novu vezu, mikromehaničku, kojom se osigurava tzv. mikromehanička sredina. On je ustavio, da se tim postupkom ranije hidrofobna i niskoenergetska površina gleđi pretvara u vlažniju, visokoenergetsku površinu, kojom se postiže znatno povećanje retencijske površine, potrebne za stvaranje zubaca i makromolekulskih lanaca ubaćene smole. Primenom invazionog metoda zalivanja fisure, koja podrazumeva blago proširenje fisure i primenom kondicioniranja gleđi postiže se još veća mikromehanička celina, pri čemu se povećava retencionia sposobnost zalivača.<sup>9,11</sup>

Rezultate koje smo dobili za kompozitne zalivače (Fisural i Fisurit-F) u početnim opservacionim intervalima pokazuju dobru adheziju u ulaznom delu fisure. Usled delovanja okuzalnih sila, dolazi do narušavanja marginalnog pripoja na ulazu u fisuru. Ovaj defekt se spaja sa već postojećim uz bočne zidove i omogućava cirkulaciju tečnosti iz usne duplje.

Ionosit-seal ne pokazuje promene u debljini i kontinuitetu nanetog sloja preparata i posle 1-ne godine od zalivanja.

## Discussion

The specific fissure morphology gives a condition that caries lesion in fissure cannot be avoided in spite of balanced nutrition, daily hygiene of oral cavity, combined fluorination and regular dentist's check-ups whereupon a need arises of preventive grasp in the area of the very fissure.

As proved by Brannstrom,<sup>25</sup> Della Volpe,<sup>10</sup> Fucks et al.,<sup>26</sup> Gift et al.,<sup>8</sup> for stopping initial progressing lesions, in the application of the means for sealing, what is necessary is the meaning of the narrow bent edge of filling by which pits and fissures are sealed.

Marginal adaptation or intimate contact between enamel and sealants is an essential factor with this preventive procedure. Each edge permeation which enables diffusion of oral fluid is a potential danger for creation of secondary caries. Numerous investigations have shown that the marginal relations between walls of fissures and sealants are not fixed, inert and nonpermeable edges but they are microcracks in which a very intensive transfer of ions and molecules is going on.<sup>26,27</sup>

By eating the enamel Bounocore realised a new connection, micromechanical, by which so called micromechanical environment is secured. He found out that by this procedure an earlier hydrophobic and lowenergetic surface of enamel turns into a more damp, highenergetic surface which leads to achieving a considerable increase of retention surface needed for creation of teeth and macromolecule chains of the inserted resin. By applying invasive method of sealing fissure, which implies slight widening of the fissure and by applying conditioning of the enamel, even more micromechanical unity is achieved whereupon retention ability of sealants is increased.<sup>9,11</sup>

The results we obtained for composite sealants (Fissural and Fissurit-F) in the beginning observation intervals show good adhesion in the entrance part of the fissure. Owing to the activity of occlusion forces, there is disturbance of the marginal joining at the entrance of the fissure. This defect is joined with the already existing one along the side walls and enables circulation of fluids from the mouth cavity.

Potvrdu ovih rezultata nalazimo na fotografijama dobijenim Scanning elektronskim mikroskopom-JEOL-5300.

Adhezija za gled je veoma jaka kod Ionosit-a-seal®-glas-jonomer zalivača ojačanog smolom ili hibridnog glas-jonomer zalivača. Adhezija za gled se naglo povećava u prva 24h, zatim na rednih meseci neznatno opada, da bi se kasnije održavala na optimalnom nivou. Hibridni glas-jonomer zalivači pokazuju hidrotermičku stabilnost, kada je reč o dugotrajnoj adhezivnoj sposobnosti.<sup>20</sup>

Do sličnih rezultata u SEM analizi došli su i drugi autori.<sup>15,21,28,29,30,31</sup>

Fajen,<sup>15</sup> Sidhn,<sup>21</sup> Miura<sup>29</sup>, Raadal<sup>30</sup> u svom radu izneli su podatke da kod kompozitnih zalivača postoji marginalna propustljivost, za razliku od glas-jonomera ojačanih smolom, gde ne postoji marginalna propustljivost.

Forsten<sup>28</sup> navodi da glas-jonomer zalivači, pokazuju manju, skoro nikakvu marginalnu propustljivost u SEM analizi u odnosu na druge zalivače-kompozitne koji sadrže fluoride. Sounders i sar.<sup>31</sup> iznose rezultate SEM analize kompozitnih zalivača, gde postoji mikro-pukotina, što je u skladu sa našim nalazima koji potvrđuju bolju retenciju hibridnih glas-jonomer zalivača u odnosu na kompozitne zalivače.

## Zaključak

- SEM nalaz je potvrdio najbolju površinsku retenciju Ionosit-a-seal® i nakon opservacionog perioda od jedne godine.
- SEM nalaz ispitivanja potpune retencije Fisurit-a-F®, pokazao je prisutnost u fisuri sa smanjenom debljinom sloja u odnosu na Ionosit-seal®, nakon 1-ne godine.
- SEM analizom prisutnosti i debljine zalivača Fisural-a®, utvrđena je prisutnost u fisuri ali sa najmanjom debljinom sloja zalivača u odnosu na Fisurit-F® i Ionosit-seal®, za najduži opservacioni period.

Ionosit-seal does not show changes in thickness and continuity of the placed layer of preparation even after 1 year from the sealing.

We find the confirmation of these results on the photographs obtained by scanning electronic microscope JEOL 5300.

Adhesion to enamel is very strong with Ionosit-a-seal-glass-ionomer® sealant resin reinforced or hybrid glass-ionomer sealant. Adhesion to enamel is abruptly increased in the first 24 hours then in the months to come it slightly falls in order to be later maintained at an optimal level. The hybrid glass-ionomer sealants show hydrothermic stability when it comes to a long-term adhesive ability.<sup>20</sup>

Other authors as well came to similar results in SEM analysis.<sup>15,21,28,29,30,31</sup>

Fajen,<sup>15</sup> Sidhn,<sup>21</sup> Miura<sup>29</sup> Raadal<sup>30</sup> in their work demonstrated the data that with composite sealants there is marginal permeability as a difference from glass-ionomers resin reinforced where there is no marginal permeability.

Forsten<sup>28</sup> states that glass-ionomer sealants show smaller, almost not at all, marginal permeability in the SEM analysis in relation to other sealants-composite which contain fluorides.

Sounders et al.<sup>31</sup> demonstrate the results from the SEM analysis with composite sealants where there is microcrack.

## Conclusion

- The SEM result confirmed the best surface retention of Ionosit-a-seal® and after an observation period of one year.
- The SEM result of examining a full retention of Fissurit-F® showed the presence in the fissure with reduced thickness of the layer in relation to Ionosit-seal®.
- By the SEM analysis of the presence and thickness of the sealant Fissural®, there has been determined the presence in the fissure but with the smallest thickness of the sealant layer in relation to Fissurit-F® and Ionosit-seal®.

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**KONFERENCIJE, KONGRESI I KURSEVI****CONFERENCES, CONGRESSES AND COURSES**

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